Techno-economics of ICT infrastructures: The impact of (user, network) requirements

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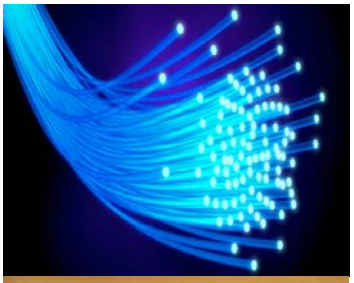

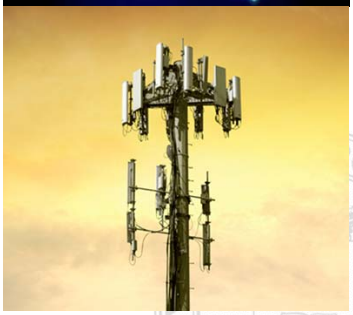

Panel "Techno-economics methodologies for evaluating ICT infrastructures"
25th European Regional ITS Conference
Brussels, 22-25 Jun 2014

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- Towards a methodology for prospective deployment of ICT infrastructures
  - (Technologies & Architectures)
  - Key deployment parameters (network requirements)
  - User requirements
- A proposal for Cost-Benefit Analysis

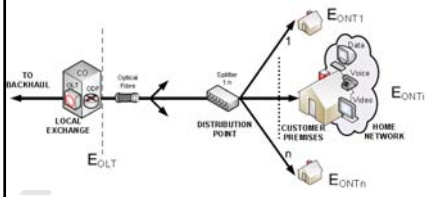
Deployment

Methodology for prospective deployments: bottom-up

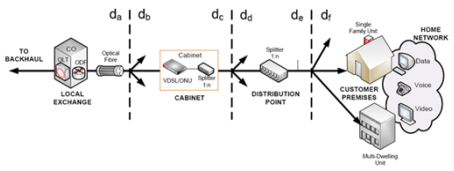
- **Technological choices** for infrastructure deployment: VDSL, FTTx, HFC, 4G, other (IoT, sensors, mesh networks, apps, …)
- **Infrastructure architecture**: re-use of existing infrastructures, technical evolution, regulatory framework
- **Design** parameters (**infrastructure requirements**): traffic profile (usage / demand), QoS, coverage, deployment strategic choices, …
- **Socio-economic** / demographic analysis (**user requirements**): geographical clustering, demand evolution
- **Cost calculation** procedure: capex, opex, financial analysis
- Revenues calculation, (social) benefits
- **(Energy** calculations)
- **Baseline evolution** and alternative scenarios (sensitivity analysis)

Deployment

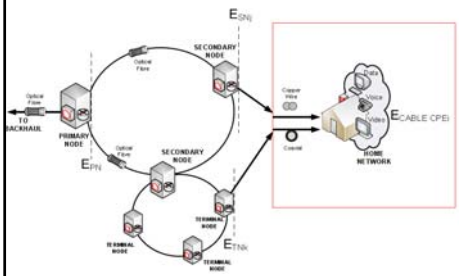
Infrastructure design in a nutshell (I): Access network architecture



FTTH



FTTx/VDSL



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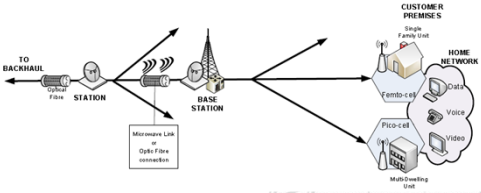

LTE

Deployment

Infrastructure design in a nutshell (II): Key network requirements

- **Mobile** data traffic: 50% annual growth until 2020, from 1,3 EB/month (2012) to almost 40 EB/month

Data traffic capacity of the (mobile) network

DTC (bps/km²) = **SpEff (bps/Hz)** x **BW (Hz/cell)** x **CUs (cell/user)** x **AR (user/inh)** x **PopD (inh/km²)**

- SpEff (bps/Hz): Spectral efficiency
- BW (Hz/cell): Bandwidth allocated to operator
- SpEff + BW: Technology & Policy (cell throughput)
- CUs (cell/user): Strategy (QoS)
- AR (user/inh): Demand (adoption rate)
- PopD (inh/km²): Population density (socio-demographics)

Deployment

Infrastructure design in a nutshell (III): User requirements

- Forecast of the number of **infrastructure users**
- **Scenarios** of services
- Forecast of the **penetration** / number of users for each service
- Forecast of the **intensity of usage** for each service
- Forecast of the **evolution of technical requirements** for each service
- **Combined usage** of services

Deployment

Network design in a nutshell (IV): Forecast of data rates per subscriber

Year	2013	2014	2015	2016	2017	2018	2019	2020
Worldwide mobile data traffic (petabytes)	2.40	4.20	6.90	10.80	15.45	22.00	29.68	40.00
Growth y-y of total mobile data	85%	75%	64%	57%	43%	42%	35%	35%
Usage scenario	Mobile video, accessing standard TV through tablets, downloading content from cloud computing services, playing online games through tablets and smartphones		Mobile video, accessing HDTV through tablets, downloading content from cloud computing services, playing advanced online games through tablets and smartphones, using simple augmented reality applications				Ultra HDTV, cloud computing, advanced online games, augmented reality apps	
Data rate per average user* (Mbps)	**1.60**	**1.93**	**3.58**	**3.98**	**4.31**	**4.59**	**8.58**	**9.11**
Vuser** (Mbps)	2	2	3	3	5	5	5	5
Contention ratio	16	16	8	4	2	1	1	1
Base station throughput (Gbps)	0.6	0.9	1.8	1.8	3.6	3.6	3.6	3.6

** Data rate for the combination of scenario services **Guaranteed user data rate*

Deployment

To discuss: Towards Cost-Benefit Analysis?

- Specification of the **set of alternative projects**
- Decision on **which costs and benefits are relevant** in the context of the project
- Catalogue the **impact categories** and indicators for measurement of each of them
- **Predict the impacts quantitatively** along the lifetime of the project
- **Value economically** each of the impacts
- **Discount benefits and costs** to obtain present values
- Compute the **net benefit** of each alternative project
- Perform a **sensitivity analysis**
- Select the **recommended alternative**